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U. S. DEPARTMENT OF COMMERCE  
BUREAU OF FISHERIES

ANNUAL REPORT OF THE  
COMMISSIONER OF FISHERIES

TO THE

SECRETARY OF COMMERCE

FOR THE FISCAL YEAR ENDED JUNE 30, 1931

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U. S. DEPARTMENT OF COMMERCE

R. P. LAMONT, Secretary

BUREAU OF FISHERIES

HENRY O'MALLEY, Commissioner

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# COMMISSIONER OF FISHERIES

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UNITED STATES

GOVERNMENT PRINTING OFFICE

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# REPORT OF THE COMMISSIONER OF FISHERIES

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DEPARTMENT OF COMMERCE,  
BUREAU OF FISHERIES,  
*Washington, July 1, 1931.*

The honorable the SECRETARY OF COMMERCE.

DEAR MR. SECRETARY: I have the honor to submit the following report of the operations of the Bureau of Fisheries during the fiscal year ended June 30, 1931.

The commercial fisheries of the United States and Alaska in the calendar year 1929 furnished employment to more than 191,000 persons, of whom 123,000 were fishermen and 64,000 were in the wholesale and manufacturing industries. The catch amounted to 3,567,000,000 pounds, returning to the fishermen \$123,054,000. Commercial fishermen conduct their operations on the high seas, along the entire stretch of our extensive coast line, including Alaska, on the Great Lakes, and in interior waters.

Angling is followed in practically all waters capable of supporting fish life, and interest in this recreational pastime has tremendously increased. The Senate Special Committee on Conservation of Wild Life Resources estimates that there are 8,500,000 fishermen or anglers in the country and that the value of fishing tackle manufactured is approximately \$25,000,000.

The national Bureau of Fisheries is concerned with the wise use of this great natural resource and its maintenance and extension without danger of exhaustion. The output of fish and eggs from its 88 stations and substations located in 35 States, Alaska, and the District of Columbia approximated 7,122,000,000 during the fiscal year ended June, 1931, and included marine, anadromous, and fresh-water species of commercial importance, as well as the highly prized game fishes. The bureau supplied 119 cooperative nurseries with over 4,000,000 young fish, increased its own output of fingerling fish by 28 per cent, and salvaged more than 182,500,000 fish in the Mississippi River section. Dependence on it for fish for stocking purposes was greatly increased because of the ruinous drought of the preceding season, in which many streams completely dried up. Added fish-cultural facilities provided for under the 5-year construction and maintenance program (act approved May 21, 1930) are being established as rapidly as possible.

The bureau's program of biological research included studies of 30 important food and game fishes, expansion of its program of research in the fields of experimental fish culture and oyster farming, and direct aids to the fishermen in forecasting the abundance of certain species, in effecting means for lessening the destruction of immature and undersized fish, and in determining what restrictions were needed to conserve the supply. The completion of a modern laboratory at Seattle, Wash., provides much needed facilities for the

Pacific coast biological staff of the bureau as well as for certain of its other personnel and the staff of the International Halibut Commission.

In the field of animal nutrition the bureau, in cooperation with other agencies, has been enabled to make noteworthy and timely contributions which have demonstrated the richness of domestic fish oils in vitamins A and D, thus extending their use in animal feeding. The relative feeding value of fish meals produced by the different processes of manufacture has been indicated, and the trade shown means for improving their manufacturing methods and eliminating waste. The assistance given has been especially timely because of the depressed fats, oils, and feeds markets and has resulted both to the advantage of the fish-reduction industry in increasing the demand for domestic products and to agriculture in making these products rich in certain factors available at lower cost. To meet the growing demands for investigations in this field, the bureau has been compelled to establish a nutrition laboratory in Washington, D. C., which is now in operation. There has also been set up a temporary fishery products laboratory at Gloucester, Mass., at which point important technological studies are being continued. In the collection of annual statistics of the catch the bureau was able to cover all sections except for certain fisheries of the Mississippi River.

Alaska fishery laws and regulations for the conservation of its fisheries have been executed vigorously in an effort to assure the maintenance of this great resource. The seal herd breeding on the Pribilof Islands has been built up until it now numbers considerably in excess of 1,000,000 animals, and the current season's killing of surplus males is expected to approximate 50,000.

With the appropriation of the sum of \$6,075, available March 1, 1931, for the balance of the fiscal year for the enforcement of the law regulating the interstate transportation of black bass, as amended and approved July 2, 1930, the bureau proceeded with all possible promptness to organize a new division to perform the functions imposed by the law.

In the calendar year 1930 the fish-canning industry—the most important process of manufacture—packed 576,685,000 pounds, valued at \$82,858,000. In excess of 80,000,000 pounds of fresh fish, valued at \$12,500,000, was prepared for the market by the packaged fresh-fish trade, and 139,297,000 pounds of fish were frozen. Secondary fish products to the value of \$23,721,000 were produced by the by-products industries. During the previous year the production of cured fish amounted to more than 110,000,000 pounds, valued at \$17,500,000, and in 1930 imports of fishery products for consumption were valued at \$50,830,000, while the value of domestic exports was \$17,276,000. In comparison with 1929, there were decreases in the value of packaged fish, canned fish, secondary products, and imports and exports, while the production of frozen fish increased.

#### INTERNATIONAL RELATIONS

##### REVISED NORTHERN PACIFIC HALIBUT CONVENTION

The investigations of the International Fisheries Commission provided for under the convention with Great Britain and Canada, ratified October 21, 1924, have shown that the stock of northern

Pacific halibut is in a precarious condition, faced with ultimate exhaustion, unless the fishery is properly controlled. It will be appreciated that it is a complicated and difficult problem to exercise adequate control over a living organism, and particularly so when that organism is a species of fish inhabiting the depths of the ocean over a coastwise stretch of more than 2,000 miles. Under this convention the commission was required to make recommendations to the two Governments for concurrent action as to the regulations deemed necessary for the preservation and development of the fishery. It is a most difficult if not impracticable procedure to obtain consideration of minor regulations by the Congress of the United States and the Canadian Parliament each year. To provide a simpler, more responsive system of control a revised convention with Canada was signed on May 9, 1930, and became effective on May 9, 1931, by the exchange of ratifications at Ottawa. It was proclaimed by the President on May 14, 1931, and contains the following articles:

#### ARTICLE I

The nationals and inhabitants and fishing vessels and boats of the United States of America and of the Dominion of Canada, respectively, are hereby prohibited from fishing for halibut (*Hippoglossus*) both in the territorial waters and in the high seas off the western coasts of the United States of America, including the southern as well as the western coasts of Alaska, and of the Dominion of Canada, from the first day of November next after the date of the exchange of ratifications of this Convention to the fifteenth day of the following February, both days inclusive, and within the same period yearly thereafter.

The International Fisheries Commission provided for by Article III is hereby empowered, subject to the approval of the President of the United States of America and of the Governor General of the Dominion of Canada, to suspend or modify the closed season provided for by this article, as to part or all of the convention waters, when it finds after investigation such changes are necessary.

It is understood that nothing contained in this convention shall prohibit the nationals or inhabitants or the fishing vessels or boats of the United States of America or of the Dominion of Canada, from fishing in the waters hereinbefore specified for other species of fish during the season when fishing for halibut in such waters is prohibited by this Convention or by any regulations adopted in pursuance of its provisions. Any halibut that may be taken incidentally when fishing for other fish during the season when fishing for halibut is prohibited under the provisions of this Convention or by any regulations adopted in pursuance of its provisions may be retained and used for food for the crew of the vessel by which they are taken. Any portion thereof not so used shall be landed and immediately turned over to the duly authorized officers of the Department of Commerce of the United States of America or of the Department of Marine and Fisheries of the Dominion of Canada. Any fish turned over to such officers in pursuance of the provisions of this article shall be sold by them to the highest bidder and the proceeds of such sale, exclusive of the necessary expenses in connection therewith, shall be paid by them into the treasuries of their respective countries.

It is further understood that nothing contained in this convention shall prohibit the International Fisheries Commission from conducting fishing operations for investigation purposes during the closed season.

#### ARTICLE II

Every national or inhabitant, vessel or boat of the United States of America or of the Dominion of Canada engaged in halibut fishing in violation of the preceding article may be seized except within the jurisdiction of the other party by the duly authorized officers of either High Contracting Party and detained by the officers making such seizure and delivered as soon as practicable to an authorized official of the country to which such person, vessel or boat belongs, at the nearest point to the place of seizure, or elsewhere, as may be agreed upon. The authorities of the nation to which such person, vessel or



boat belongs alone shall have jurisdiction to conduct prosecutions for the violation of the provisions of this Convention, or any regulations which may be adopted in pursuance of its provisions, and to impose penalties for such violations; and the witnesses and proofs necessary for such prosecutions, so far as such witnesses or proofs are under the control of the other High Contracting Party, shall be furnished with all reasonable promptitude to the authorities having jurisdiction to conduct the prosecutions.

### ARTICLE III

The High Contracting Parties agree to continue under this Convention the Commission as at present constituted and known as the International Fisheries Commission, established by the Convention between the United States of America and His Britannic Majesty for the preservation of the halibut fishery of the Northern Pacific Ocean including Bering Sea, concluded March 2, 1923, consisting of four members, two appointed by each Party, which Commission shall make such investigations as are necessary into the life history of the halibut in the convention waters and shall publish a report of its activities from time to time. Each of the High Contracting Parties shall have power to fill, and shall fill from time to time, vacancies which may occur in its representation on the Commission. Each of the High Contracting Parties shall pay the salaries and expenses of its own members, and joint expenses incurred by the Commission shall be paid by the two High Contracting Parties in equal moieties.

The High Contracting Parties agree that for the purposes of protecting and conserving the halibut fishery of the Northern Pacific Ocean and Bering Sea, the International Fisheries Commission, with the approval of the President of the United States of America and of the Governor General of the Dominion of Canada, may, in respect of the nationals and inhabitants and fishing vessels and boats of the United States of America and of the Dominion of Canada, from time to time,

- (a) divide the convention waters into areas;
- (b) limit the catch of halibut to be taken from each area;
- (c) fix the size and character of halibut fishing appliances to be used therein;
- (d) make such regulations for the collection of statistics of the catch of halibut including the licensing and clearance of vessels, as will enable the International Fisheries Commission to determine the condition and trend of the halibut fishery by banks and areas, as a proper basis for protecting and conserving the fishery;
- (e) close to all halibut fishing such portion or portions of an area or areas, as the International Fisheries Commission find to be populated by small, immature halibut.

### ARTICLE IV

The High Contracting Parties agree to enact and enforce such legislation as may be necessary to make effective the provisions of this Convention and any regulation adopted thereunder, with appropriate penalties for violations thereof.

### ARTICLE V

The present Convention shall remain in force for a period of five years and thereafter until two years from the date when either of the High Contracting Parties shall give notice to the other of its desire to terminate it.

This Convention shall, from the date of the exchange of ratifications be deemed to supplant the Convention between the United States of America and His Britannic Majesty for the Preservation of the Halibut Fishery of the Northern Pacific Ocean including Bering Sea, concluded March 2, 1923.

### ARTICLE VI

This Convention shall be ratified in accordance with the constitutional methods of the High Contracting Parties. The ratifications shall be exchanged at Ottawa as soon as practicable, and the Convention shall come into force on the day of the exchange of ratifications.

## PASSAMAQUODDY POWER PROJECT

By joint resolution (Pub. Res. No. 83, 71st Cong.) approved June 9, 1930, Congress authorized an appropriation to defray the United States' share of the expenses of an investigation, to be made jointly by the United States and Canada, of the probable effects on the fisheries of the proposed international developments to generate electric power from the movements of the tides in the Passamaquoddy and Cobscook Bays region. The President appointed Henry O'Malley, Commissioner of Fisheries, and O. E. Sette, in charge of North Atlantic fishery investigations of this bureau, as the United States commissioners to conduct the investigations. Wm. A. Found, Deputy Minister of Fisheries, and Prof. A. G. Huntsman, of the Biological Board of Canada, were appointed to represent Canada.

The commission met on June 8, 1931, in Montreal to organize and to consider arrangements for initiating the investigation. Mr. Found was chosen chairman and plans were made for the selection of four responsible investigators to conduct investigations on zooplankton, phytoplankton, oceanic chemistry, physical oceanography, and fisheries. The investigations are planned along the following lines:

1. Detailed study of the occurrence of the herring in relation to various environmental conditions as an indication of how its availability in the fishery might be affected by the construction of the dams.

2. A study of the abundance of phytoplankton and zooplankton (as a basis for fish life) in relation to the physical and chemical states of the water in the Bay of Fundy and along the coast of Maine.

3. Detailed examination of existing hydrographic conditions as indicating the relative importance of the water mixing at the mouth of Passamaquoddy Bay as determining the physical and chemical states of the water in the Bay of Fundy and along the coast of Maine. The commission and investigative staff will be aided by an advisory committee of four scientists. For Canada these are: Prof. F. R. Hayes, zoological department, Dalhousie University, and Dr. A. W. H. Needler, in charge of oyster investigations; and for the United States, Dr. H. B. Bigelow, director of the Woods Hole (Mass.) Oceanographic Institution, and Prof. A. E. Parr, curator, Bingham oceanographic collection, Yale University.

## NORTH AMERICAN COUNCIL ON FISHERY INVESTIGATIONS

The council held its seventeenth meeting in Washington, D. C., on November 6 and 7, 1930, with representatives from Canada, France, Newfoundland, and the United States present. The meeting concerned itself with a wide range of subjects dealing with the practical and scientific problems of our North Atlantic fisheries in keeping with its purpose to coordinate the program of research along eminently practical lines. Reports on investigations of the cod, haddock, mackerel, herring, and squid fisheries, the Passamaquoddy power project, ocean currents and temperatures, and fishery statistics were received. Dr. Ed. le Danois, director of the marine-fisheries work in France, gave a very interesting account of the movement of North Atlantic waters and their effects on the fisheries, and the Hon. H. B.

C. Lake, Minister of Marine and Fisheries of Newfoundland, emphasized the seriousness of the bait situation and need for assuring to the fishermen adequate supplies of bait material. Dr. Harold Thompson, a well-known investigator of the Scottish Fishery Board, who is cooperating with the Newfoundland Government in working out a program of fishery research, was present.

#### INTERNATIONAL COLONIAL EXPOSITION AT PARIS

In connection with the participation by the Government of the United States in the International Colonial and Overseas Exposition at Paris from May 1 through October, 1931, the bureau prepared an appropriate display regarding the fishery and fur-seal industries of Alaska. The articles assembled included a life-size reproduction of a chinook salmon, models of salmon steaks and fillets, salmon and clam cans and labels, a mounted fur seal, several dressed and dyed fur-seal skins, and two fur-seal coats. Appropriate photographic presentations were also included.

#### CONSERVATION OF WHALES

At one period the United States led all nations in the prosecution of the whale fisheries. It still produces from one to one and a half million gallons of whale oil and imports over seven million gallons, making it a large consumer of this product.

During the past quarter of a century the prosecution of this fishery on all seas has been greatly intensified. The development of floating factory ships with a displacement up to 30,000 tons or more, some of the larger with storage space for three and one-half to six million gallons of oil, has made possible an intensive exploitation of the fishery in Antarctic waters. The mother ship is accompanied by a fleet of "killers," smaller swift vessels, to scour the seas and tow the catch to the factory ship. On some of these factory ships there is provision for hauling the whales aboard for cutting up, thus greatly simplifying reduction operations.

The world catch of whales increased from about 12,000 in the calendar year 1920 to more than 27,500 in 1929, and the production of whale oil increased from nearly 20,400,000 gallons to 93,400,000 gallons in this 10-year period.

This intensified pursuit of whales in practically all seas of the globe has aroused grave concern lest the supply be exhausted and the investment in the industry, which has yielded over \$60,000,000 in products in a year, be jeopardized. Because of the cosmopolitan character of whales and the number of countries engaged in the fishery, regulation would appear necessary by international agreement. In Europe some provision for the study of the subject has been made, and several nations have applied some restrictions on the operation of their nationals. In this country the question is receiving attention by the Special Committee on Wild Life Resources of the United States Senate, the American Society of Mammalogists, and other conservation agencies.

Among the protective measures which should receive attention are the prevention of the capture of certain of the rarer species, the killing of immature whales of whatever species, and the undue exploita-



tion of the fishery as a whole. It may be necessary to provide for the licensing of whaling companies, setting forth the terms under which they shall operate, including as complete utilization of the animals killed as is practicable. It is also highly important that an international agency be established for a more intensified study of the trend of the fishery, the need for regulations, and the character of regulations essential to prevent the exhaustion of the supply, with as little interference with commercial operations as possible.

#### JAPANESE VESSELS IN BERING SEA

The summer of 1930 marked the advent of Japanese vessels in Bering Sea waters adjacent to the Alaskan coast for the packing of crabs. The floating cannery steamer *Taihoku Maru*, a vessel of over 7,000 tons, accompanied by the steam beam trawler *Myogi Maru* and a number of power launches, was operated about 20 miles offshore from Nelson Lagoon on the Alaska Peninsula. A pack of upward of 20,000 cases of crabs was made. The trawler *Kokusai Maru*, a vessel 118 feet in length, engaged in experimental fishing in Bristol Bay waters 15 or more miles offshore in August, 1930, a small take of cod, crabs, and halibut resulting. In addition, the Japanese Government vessel *Hakuyo Maru* made a trip in 1930 to waters of Bering Sea. This is a training ship of the Imperial Fisheries Institute of Tokyo and is a modern steel vessel of about 2,000 tons. In the summer of 1931 the floating cannery *Nagato Maru* was engaged in the packing of crabs in Bering Sea waters a few miles north of the Alaska Peninsula.

#### DOMESTIC RELATIONS

##### AID TO OUR ISLAND DEPENDENCIES

*Hawaiian pearl oysters.*—At the invitation of the Territorial government of Hawaii, the bureau detailed its oyster expert, Dr. P. S. Galtsoff, to an investigation of the newly discovered pearl-oyster resources of Pearl and Hermes Reef for the purpose of developing a conservation policy. Transported from Honolulu on July 15, 1930, by the Navy mine layer *Whippoorwill* and accompanied by 3 Philippine divers, Doctor Galtsoff spent 5 weeks in making a series of biological investigations at 75 stations in the lagoon where the oysters occur. Pearl oysters were found at depths from 10 to 47 feet, attached almost exclusively to live corals. All oyster reefs examined showed obvious signs of depletion. One-year-old oysters were very few in number. The oysters spawn in July and August. It is estimated that since 1927, when these beds were discovered, not less than 100 tons of shells (about 106,000 oysters) were taken; and, without protection, the beds will be completely wiped out in a short time. The closure of the beds to fishing for a period of 3 to 5 years was recommended. Several hundred live oysters were brought back to Honolulu and planted in Kaneohe Bay, where conditions appeared to be suitable for their growth and propagation. An examination of this stock made on April 17, 1931, disclosed that the oysters were doing well, those examined having nearly doubled in size since they were planted in the previous September. The Territorial government



is making arrangements to bring more oysters from Pearl and Hermes Reef in the continuance of the restocking policy.

*Fisheries of the Virgin Islands.*—R. H. Fiedler and N. D. Jarvis, on May 2, 1931, were detailed to conduct a survey of the fisheries of the Virgin Islands of the United States with a view to alleviating the present economic plight of these islands. Work began on May 15, 1931, in St. Thomas, and the preliminary survey was completed on May 30, 1931. The survey revealed that during the calendar year 1930 the fisheries of the Virgin Islands of the United States employed 405 fishermen. Their catch amounted to 616,000 pounds of fishery products valued at \$49,080 to the fishermen. In making the catch the fishermen used 1 motor boat, 38 sailboats, and 147 rowboats. The gear employed consisted of 40 haul seines, 90 tangle nets (turtle), 113 cast nets, 297 lines, and 1,600 set pots. About one-third of the total catch was made by set pots, one-third by seines, and one-third by lines or other types of gear, and by hand. In addition, it was determined that the industry in the islands is faced with the problem of marketing the catch now obtained rather than the lack of a sufficient supply. There is reason to believe that there are many times throughout the year when the local markets are glutted with fish, making it impossible to dispose of the catch. Two plans appeared feasible for relieving the situation. These are: (1) Expand the market for fresh fish; (2) establish a local fish-curing industry to replace imported cured fish. In order to further these plans Mr. Jarvis remained in the islands for several weeks to conduct experiments along these lines. These experiments have proved successful; and if the findings are adopted it is believed that the economic welfare of the fisheries of the islands will be materially improved.

#### FISHERIES CONFERENCES

On October 27 and 28, 1930, the bureau was represented at an important interstate fishery conference at Savannah, Ga., called by the fish and game commissioner of Georgia to consider various fishery problems of common interest to North Carolina, South Carolina, Georgia, and Florida, with special reference to oysters, shad, and shrimp. The conference adopted a resolution favoring extension of private oyster culture and the application of modern methods of oyster farming, also one favoring restriction of the shad fisheries, protection of spawning grounds, and provision for escapement of a sufficient spawning reserve.

At the invitation of the Commissioner of Fisheries, conservation officials and leading conservationists of Maryland, Virginia, West Virginia, Pennsylvania, and the District of Columbia met at the bureau on December 9, 1930, to formulate a program for the rehabilitation of the game fishes, particularly the black bass, the control of pollution, and the protection of the shad in the Potomac River.

Resolutions were passed recommending (1) uniform laws governing the fisheries in boundary waters; (2) measures designed to afford the black bass proper protection; (3) effective laws for the protection of the shad; (4) the enactment of legislation by the States for more complete sewage and trade waste disposal; (5) provisions for cooperative study on means for disposing of industrial wastes; and (6) the prevention of the pollution of streams.

In providing effective cooperation with the Federal Government in the enforcement of the black bass law it was recommended that the States (1) prohibit the sale of black bass whether taken within or without the State; (2) provide entire closure to fishing during the spawning season of the bass; (3) prohibit the export of bass, allowing the nonresident licensee to carry out a 2-day bag limit; (4) provide a uniform size limit; and (5) provide a daily bag limit; and further that the Federal and State agencies increase their output of young bass to care for the demand from private cooperative agencies desirous of rearing the young to fingerling sizes for stocking purposes and for more generous plantings in the streams.

### COOPERATION WITH STATES

With the work of the bureau extending into every State, cooperative arrangements are frequently entered into with the various agencies engaged in similar work. This prevents duplication of effort and effects a considerable saving of money for all concerned.

In its limnological survey of Lake Erie the bureau has been aided by the States of Ohio and New York. Similar arrangements exist with Wisconsin in the lake work of that State. Cooperative arrangements with Georgia, Louisiana, and Texas in the shrimp work have greatly enlarged its scope, the two former States financing the operations of two of the bureau's vessels assigned to their waters. California is assisting with the trout and steelhead salmon studies on the Pacific slope. The oyster work of the bureau has been materially aided by the cooperation of Virginia, North and South Carolina, Georgia, Oregon, and Washington. In the fish cultural work the Rocky Mountain States have been very helpful in the program of restoring the depleted streams of this popular fishing section to former abundance by mutually beneficial cooperative egg collecting and rearing operations. In addition, cooperation has been received in this work from many of the other States, notably Michigan, Minnesota, Washington, and Oregon. In so far as personnel is available expert advice has been freely granted to State and private fish-culturists in the solving of their various problems. Exceptional cooperation also has been received in the collection of statistics. Many States furnish data so complete that only supplemental surveys need be made by the bureau's agents. In the enforcement work of the new black bass law the bureau, on account of limited funds, has had to depend on State help and cooperation to expedite the program. This has been freely given, and many of the States are assisting by allowing the appointment of their regularly employed State fish and game protectors to the cooperative position of Federal black bass law inspectors, for which they receive no remuneration, thus rendering a distinct service in a very material way.

In addition to the States, the Navy Department, through the transporting of supplies to the Pribilof Islands, has given valuable and much appreciated aid and, together with the War Department, has loaned vessels for other services as well. The United States Forest Service and the National Park Service rely upon the bureau for fish for stocking the streams and lakes in their reservations and cooperate to the fullest extent.

## FIVE-YEAR CONSTRUCTION AND MAINTENANCE PROGRAM

The act of May 21, 1930 (46 Stat. 371), entitled "An act to provide for a 5-year construction and maintenance program for the United States Bureau of Fisheries," authorized, among other things, the establishment, during the fiscal year 1931, of fish cultural stations in New Mexico, Louisiana, and Idaho; fish cultural substations in Wisconsin, Montana, Colorado, and New Hampshire; a fishery laboratory in the State of Washington; and an experimental bass and trout station in Maryland or West Virginia. A total of \$505,000 was authorized to be appropriated for the establishment of these projects. The second deficiency act, fiscal year 1930, appropriated \$265,000 for the fiscal year 1931 to enable the bureau to establish or to commence the establishment of these projects.

Sites suitable for the establishment of the fish-cultural substation in New Hampshire and for the fishery laboratory in the State of Washington were available on land already owned by the United States and consequently their establishment was begun early in the fiscal year and practically completed. The New Hampshire station is located in the White Mountain National Forest near the town of West Milan. The laboratory is located at 2725 Montlake Boulevard, Seattle, Wash., on land known as the "Old Lake Washington Canal right of way."

Sites near Natchitoches, La., Leadville, Colo., and Charles Town, W. Va., were acquired for the establishment of the stations in those States and construction was begun during the year.

Sites near Dexter, N. Mex., Gooding, Idaho, and Lake Mills, Wis., were selected for the stations to be established in those States; but title to these sites was not perfected during the fiscal year, and necessarily construction could not be begun.

## PROPAGATION AND DISTRIBUTION OF FOOD AND GAME FISHES

## INTRODUCTION

The operations of the fish-cultural division of the Bureau of Fisheries include the propagation and distribution of marine and fresh-water fishes. As a result of such activities during the fiscal year 1931, 7,121,806,000 fish and eggs were produced and distributed. This represents a decrease in output of 448,677,000 as compared with the preceding year.

Two important facts to be taken into consideration in comparing the output of one fiscal year with that of another are the amount of equipment employed and the size of the fish produced. The equipment in operation during 1931 was essentially the same as in 1930. Carp propagation was suspended at the Put in Bay (Ohio) station. Ponds for warm-water fishes were constructed in rice fields in the vicinity of Orangeburg, S. C. At Pyramid Lake, Nev., extensive collections of black-spotted trout eggs were made. Black bass ponds covering an area of approximately 4 acres were completed at the Cape Vincent (N. Y.) station and placed in operation. These changes were not of great magnitude, and the equipment employed



during the two years may be considered on an approximately equal basis.

The experience gained in the planting of large fingerling and yearling trout, salmon, and other fishes that can be reared to fingerling and yearling sizes has demonstrated that the distribution of such fishes in the egg and fry stages should not be resorted to except when lack of adequate facilities makes it imperative. The significance of the planting of 1,000 large fingerling fish might easily overshadow the planting of many times that number of fish of the same species in the fry stage. Because of this fact much of the expansion of fish-cultural equipment and effort for the production of certain fishes has taken place with the view to producing fish of larger size rather than increasing the numerical output.

The continued efforts put forth by the bureau to produce larger fish have resulted in the distribution of a greater proportion of the output in the fingerling stage. Such increase in the fiscal year 1931 as compared with the fingerling production of the preceding year amounted to 28 per cent. Since these larger fish require more space and care than fish in the fry stage, it might be assumed that the total production of the hatcheries in operation would be proportionately reduced. As a matter of fact, however, only two species of salmon—steelhead and chum—showed any appreciable decrease in numbers as compared with 1930, while the chinook, sockeye, humpback, and Atlantic salmons showed a substantial increase in production. The output of the other salmons and trout handled did not vary markedly from the figures of the preceding year.

There was an increased output of practically all the important commercial and game species handled, and in the case of the shad, herring, cisco, pike perch, and winter flounder such increases were large. The decline in the total output may be ascribed largely to a falling off in the production of cod and pollock, such decrease amounting to 1,135,999,000. These species are distributed in the egg and fry stages, and the egg collections are dependent upon the weather conditions encountered rather than upon the efficiency and effort put forth by the egg-collecting crews. Aside from the cod and pollock operations, the fiscal year 1931 may be regarded as a most successful year from a propagation and distribution standpoint. The year's output, classified according to the character of the fishes handled, may be summarized as follows:

Game fishes:

Warm-water species—

	Number
Basses -----	4, 370, 000
Sunfish -----	12, 653, 000
Crappie -----	28, 549, 000
Pike and pickerel -----	3, 927, 000
Catfish -----	84, 521, 000
Other -----	101, 000

Cold-water species:

Trouts—

Brook -----	16, 296, 000
Rainbow -----	13, 389, 000
Loch Leven -----	16, 702, 000
Black-spotted -----	16, 095, 000
Golden -----	25, 000
Grayling -----	1, 003, 000
Landlocked salmon -----	708, 000



## Commercial fishes:

Anadromous species—	Number
Shad.....	19, 490, 000
Glut herring.....	50, 000, 000
Striped bass.....	9, 500, 000
Salmon—	
Atlantic.....	3, 969, 000
Pacific.....	175, 748, 000
Interior waters (including Great Lakes) species—	
Whitefish.....	157, 415, 000
Cisco.....	63, 400, 000
Lake trout.....	25, 729, 000
Pike perch.....	195, 353, 000
Yellow perch.....	115, 298, 000
Carp.....	138, 023, 000
Buffalofish.....	115, 488, 000
Marine species—	
Cod.....	1, 525, 298, 000
Haddock.....	447, 428, 000
Pollock.....	240, 219, 000
Winter flounder.....	3, 604, 668, 000
Mackerel.....	10, 461, 000
Miscellaneous fishes.....	25, 980, 000
Total.....	7, 121, 806, 000

## PROPAGATION OF COMMERCIAL SPECIES

*Marine species of the Atlantic coast.*—As the fishes propagated by the bureau in this section are extremely prolific, the eggs are taken in immense numbers. Most of them are incubated in hatcheries and the fry liberated soon after hatching. However, the low-water density experienced in some of the egg-collecting fields makes it imperative to plant the green eggs on the spawning grounds immediately after fertilization has been accomplished. A considerable increase may be noted in the distribution of haddock and winter flounder. On the other hand, the production of cod and pollock fell far short of the results with these species in the preceding year.

*Pacific salmon.*—The output of Pacific salmon was considerably in excess of last year's production. Owing to the more favorable conditions existing on the spawning grounds in the Columbia River and in California, the egg collections of the chinook salmon exceeded those of last year by more than 40,000,000. More eggs of the humpback salmon than last year were taken in the Afognak (Alaska) field.

*Anadromous species of the Atlantic coast.*—A comparatively successful year was experienced in the propagation of shad. A prolonged period of cool weather lengthened the spawning season, and while the egg collections did not equal those in the spring of 1929, they exceeded the take in 1930 by a substantial margin. Eggs of the striped bass were again collected at Weldon, N. C., after a year of no production in 1930. Atlantic salmon propagation was augmented at the Craig Brook (Me.) station by the acquisition of several million additional eggs from Canadian hatcheries, and at Edenton, N. C. the 1930 take of herring eggs was surpassed by upward of 70,000,000.

*Commercial species of interior waters.*—Increases over 1930 figures may be noted in the 1931 distributions of the fishes coming under

this head. Pike perch and cisco showed large increases, the Put In Bay (Ohio) station producing a very satisfactory output of the former. The whitefish production exceeded that of 1930, due mainly to more satisfactory working conditions in the Michigan field. Notwithstanding the fact that carp propagation was suspended at the Put In Bay station, a large increase in the carp output was made possible through operations conducted at Bellevue and Guttenberg, Iowa, in the La Crosse (Wis.) field.

#### PROPAGATION OF GAME FISHES

Although a number of the commercially important fishes are sought by anglers for their sporting qualities, many of them are not included in the category of game fishes. Only the trouts, basses, sunfish, crappie, catfish, pike, pickerel, grayling, and related forms are comprised under that heading.

During the year difficulties were experienced at some of the pondfish stations on account of the prevailing drought. Large losses of black bass and other pondfishes were also sustained because of the varying weather conditions experienced during the spawning season. Notwithstanding these handicaps, however, the year's distribution of the pondfishes was only slightly lower than in 1930. In all sections a sufficient number of the various species was produced to fill all applications on file and to allow for the utilization of an ample surplus for carrying on extensive cooperative activities with States, sportsmen's organizations, and individuals.

#### RESCUE OPERATIONS

The extent of the rescue work in the Mississippi River territory exceeded that of the previous year. The total of salvaged fish handled in the fiscal year 1931 amounted to 182,534,861, and of this number less than 1 per cent was used to fill applications outside of the rescue district. Weather conditions were unusually favorable during the season, and the number of fish rescued constituted a new record. The results of the rescue work in the fields surrounding the Fairport (Iowa) biological station were also very successful.

#### COOPERATIVE ACTIVITIES

The cooperative nursery system has become an integral part of the bureau's propagation work. Through its activities the bureau has been enabled to extend materially the scope of its fish-cultural operations. The removal of large numbers of young fish to be reared at the nurseries has reduced the mortality formerly resulting from the crowded condition of the hatcheries and has made possible the concentration of effort in rearing the retained stock to a comparatively large size prior to distribution. While the drought and other conditions caused the suspension of activities at a number of these establishments, the 119 in operation received for rearing during the year a total of 4,109,622 young fish produced at the bureau's hatcheries.

## STATISTICAL SURVEYS

The statistical work of the division of fishery industries includes the collection and dissemination of biological and trade-fishery statistics. Continued progress was made toward the collection of annual statistics of the entire country by the cooperation of State fishery agencies and by the use of automobiles by agents. As a result, catch statistics for 1929 were obtained for the fisheries of the entire United States with the exception of certain fisheries of the Mississippi River and tributaries.

## FISHERIES OF THE UNITED STATES AND ALASKA

*New England States.*—In the calendar year 1929 the fisheries of Maine, New Hampshire, Massachusetts, Connecticut, and Rhode Island employed 17,160 fishermen, or 3 per cent more than in 1928. The catch amounted to 694,286,086 pounds, valued at \$29,072,566—an increase of 15 per cent in the catch and 13 per cent in value as compared with 1928.

In 1930 landings of fish by American vessels at Boston and Gloucester, Mass., and Portland, Me., amounted to 350,801,470 pounds as landed, valued at \$12,785,452—an increase of 7 per cent in volume over 1929.

The catch of the mackerel fishery in 1930 amounted to 43,156,885 pounds, which is a decrease of 7 per cent as compared with 1929.

In 1930 the packaged-fish trade in New England decreased 7 per cent in amount and 18 per cent in value as compared with 1929.

The sardine canners in Maine packed 1,399,212 standard cases, valued at \$4,459,071, during 1930—a decrease of 31 per cent in quantity and 35 per cent in value as compared with 1929.

*Middle Atlantic States.*—In the calendar year 1929 the fisheries of New York, New Jersey, Pennsylvania, and Delaware employed 10,491 fishermen, or 5 per cent more than in 1926, the most recent year for which statistics are available prior to 1929. The catch amounted to 190,772,611 pounds, valued at \$14,137,608—an increase of 14 per cent in the catch and 13 per cent in the value of the catch as compared with 1926. Landings of fish at New York City and Groton, Conn., amounted to 57,255,000 pounds in 1930, or 24 per cent less than in 1929.

On the Hudson River the shad fishery was carried on by 243 fishermen in 1930, who caught 206,504 pounds of shad, valued at \$33,372—a slight increase over 1929.

*Chesapeake Bay States.*—In the calendar year 1929 the fisheries of Maryland and Virginia employed 18,470 fishermen, or 26 per cent less than in 1925, the most recent year for which records are available prior to 1929. The catch amounted to 274,673,437 pounds, valued at \$11,580,628—a decrease of 18 per cent in the catch and 17 per cent in the value of the catch as compared with 1925.

In 1930 the shad and alewife fisheries of the Potomac River were prosecuted by 608 fishermen, who caught 601,193 pounds of shad, valued at \$98,041, and 3,114,918 pounds of alewives, valued at \$49,315.

*South Atlantic and Gulf States.*—In the calendar year 1929 the fisheries of North Carolina, South Carolina, Georgia, Florida, Ala-



bama, Mississippi, Louisiana, and Texas employed 26,643 fishermen, or 7 per cent less than in 1928. The catch amounted to 535,394,859 pounds, valued at \$14,903,945—an increase of 18 per cent in the catch and a decrease of 7 per cent in the value as compared with 1928.

In 1930 sponges sold on the exchange at Tarpon Springs, Fla., amounted to 414,082 pounds, valued at \$802,938. This is an increase of 9 per cent in quantity and 14 per cent in value over 1929.

*Pacific Coast States.*—In the calendar year 1929 the fisheries of Washington, Oregon, and California employed 19,992 fishermen, or 1 per cent more than in 1928. The catch was the largest and most valuable on record, amounting to 1,034,433,666 pounds, valued at \$25,038,414—an increase of 47 per cent in the catch and 22 per cent in the value over 1928.

In 1930 the total catch of halibut by United States and Canadian vessels amounted to 49,408,000 pounds, valued at \$4,974,000—a decrease of 11 per cent in quantity and 26 per cent in value as compared with 1929.

*Lake States.*—In the calendar year 1929 the lake fisheries (Lakes Ontario, Erie, Huron, Michigan, Superior, and Namakan, Lake of the Woods, and Rainy Lake) of the United States and Canada produced 114,826,907 pounds of fish and shellfish. Of the total, the United States accounted for 85,389,467 pounds, valued at \$6,787,750. The total catch showed an increase in 1929 over 1928, due largely, however, to a revised and more complete method of collection used in the lake fisheries in 1929.

*Mississippi River and tributaries.*—During the calendar year 1930 the catch of fresh-water mussel shells amounted to 59,490,000 pounds, valued at \$1,092,156—an increase of 9 per cent in the quantity and a decrease of 18 per cent in the value as compared with 1929. The pearl-button industry, centered in Iowa, manufactured pearl buttons and various novelties from fresh-water mussel shells valued at \$5,007,419 in 1930. The fisheries of Lakes Pepin and Keokuk decreased in 1930 as compared with 1929.

#### MANUFACTURED PRODUCTS

*Canned products.*—During the calendar year 1930, 464 establishments canned fishery products in the United States and Alaska amounting to 14,767,186 standard cases (576,685,454 pounds), valued at \$82,858,261. This is a decrease of 18 per cent in the value as compared with 1929. Salmon canned on the Pacific coast accounted for 6,086,479 standard cases (292,150,992 pounds), valued at \$42,835,953. This is 52 per cent of the total value. Sardines canned in California and Maine and tuna and tunalike fishes canned in California each accounted for 16 per cent of the total value. The remainder of the production consisted principally of shrimp, clam products, and oysters.

*By-products.*—During the calendar year 1930 by-products worth \$23,720,778 were manufactured. Excluding marine-pearl shell products, statistics for which were not included in 1929, there was a decrease of 19 per cent in the value of the production. The most important by-products were marine-animal meals and scrap, fresh-



water mussel-shell products, marine-pearl shell products, marine-animal oils, and oyster-shell products. Products of lesser importance were liquid glue, herring skins and scales, shark skins, fins, and meat, agar agar, pickled whale meat, whalebone, and isinglass.

*Cured products.*—The production of cured fishery products in the marine and lake sections of the United States and Alaska in the calendar year 1929 amounted to 116,267,121 pounds, valued at \$17,822,253. Of this amount 72,842,774 pounds, valued at \$7,038,425, were salted; 36,490,815 pounds, valued at \$9,446,612, were smoked; 4,746,634 pounds, valued at \$1,214,205, were dried; and 2,186,898 pounds, valued at \$183,011, were spiced. Mild-cured salmon was the most valuable salted product, salmon the most valuable smoked product, shrimp the most valuable dried product, and alewives the most important spiced product.

*Packaged fresh, frozen, and smoked products.*—During the calendar year 1930 packaged fresh, frozen, and smoked products were produced in 128 plants operated in 15 States. The output amounted to 80,013,572 pounds, valued at \$12,579,664—a decrease of 5 per cent in quantity and 15 per cent in value as compared with 1929.

*Frozen products.*—In the calendar year 1930 the freezing plants in the United States and Alaska packed 139,297,228 pounds of frozen fishery products, with an estimated value in the cold-storage warehouses of \$16,500,000. This is the largest frozen pack on record and is an increase of 15 per cent over 1929. The most important frozen products were the group consisting of cod, haddock, haddock fillets, hake, and pollock; salmon; halibut; mackerel; whiting; and sea herring.

#### FISH-FARMING INDUSTRIES IN THE UNITED STATES

As a continuation of the work started in the calendar year 1928 when the goldfish industry was surveyed, the fish-farming industry was further studied in 1930 to include the trout and pondfish industries. It was found that there were 133 trout and 11 pondfish establishments commercially active in 1929. The products marketed in the trout industry were valued at \$1,072,700, and in the pondfish industry they were valued at \$21,444.

#### FOREIGN FISHERY TRADE

The value of the United States foreign trade in fishery products during the calendar year 1930 amounted to \$68,105,230, of which \$50,829,653 represents the value of the imports for consumption and \$17,275,577 the value of exports. Compared with the previous year, this is a decrease of 25 per cent in total trade, 24 per cent in the value of imports, and 28 per cent in the value of exports.

#### TECHNOLOGICAL INVESTIGATIONS

The technologists of the division of fishery industries have been conducting research mainly on problems relating to improvements in methods of handling fresh fish, by-products and production methods, net preservation, and the nutritive value of marine products.

## IMPROVEMENTS IN METHODS OF HANDLING FRESH FISH

During the year the bureau established a refrigeration laboratory at the municipal fish market in this city for the purpose of continuing preliminary studies on the evaporation of moisture from frozen fish, the rusting of frozen fish, the losses incurred through leaching of fish packed in ice, and the freezing of oysters. In the studies on the evaporation of moisture from frozen fish, the samples of fish were given several different treatments and stored in a constant temperature approximating the conditions of a commercial freezer as far as possible. One treatment showed up particularly well, reducing the evaporation of moisture from 23 per cent in the untreated fish to 5 per cent in the treated fish. In studying the losses incurred through the leaching of fish packed in ice, preliminary experiments indicated losses of as high as 4 pounds per ton over a period of 7 days. This, apparently, is not a great loss until it is multiplied by the amount of fish handled in crushed ice over a period of a year. It then begins to assume proportions which are really surprising. It has been recognized for several years and should be emphasized that these losses represent some of the most important constituents of the fish from a nutrition standpoint, as the leachings contain large quantities of the minerals and a part of the flavor of the fish.

During the past year experiments have been conducted on freezing oysters. If rapidly frozen oysters could be introduced for consumption in the summer months and the public induced to buy them, the annual output of the producers could be materially increased. Our experiments have demonstrated that oysters can be rapidly frozen and placed in cold storage for several months without impairing the taste.

At the time that the above-described experiments were being conducted, at the request of the authorities of the District government, our technologist offered suggestions which would tend to increase the attractiveness of the municipal fish market. These dealt with the sanitary conditions, improvements in refrigeration facilities for the stores, and general recommendations.

## BY-PRODUCTS AND PRODUCTION METHODS

Activities in this section of technology consisted in the completion of studies on the menhaden industry, manufacturing fish oils of higher vitamin potency, cooking and pressing fish, and reduction of nonoily fish waste.

The menhaden studies disclosed means for the elimination of wastage in the various stages of the factory process, the more efficient operation of machinery, possible improvements in the design of existing machinery, and the introduction of new machinery.

It has been shown that menhaden press liquors contain approximately 22 per cent of the total solids of the original material, and of this amount about 17 per cent is dissolved material and about 5 per cent is suspended material. Under present operating conditions, all dissolved materials are discarded and only about one-third of the suspended materials are recovered. Yet, by treating press liquors with a chemical coagulant, such as aluminum sulphate,

and passing the liquors through a pressure filter, the oil and water emulsion is broken and all suspended and about one-third of the dissolved solids may be recovered. Furthermore, such treatment may be expected to give a greater oil recovery.

It was demonstrated that the type of flame drier used at present in the industry causes a loss of over 10 per cent of the monetary value of the scrap dried, and that the use of steam tube driers will reduce the present loss in monetary value of dried scrap by over 50 per cent. In addition to this advantage, preliminary feeding tests indicated that steam-dried menhaden meal has greater nutritional value than the flame-dried product. Another important discovery was the fact that storing of oil in open tanks at the factory causes an increase in the free fatty acid content of the oil.

Special studies have been made of the effect of different methods of manufacture on the quality and nutritive value of the finished products. It has been shown that the intrinsic value of both fish meal and fish oil can be greatly improved through changes in manufacturing methods. Heat and oxidation, both in intensity and duration, are the great destroyers of the nutritional value of foods and feedstuffs. Therefore, any food manufacturing process which minimizes the destructive effect of heat and oxidation contributes greatly to the quality and nutritive value of the manufactured product in question.

#### NET PRESERVATION

Net preservation studies dealt with trap nets and gill nets. Chemicals of the antioxidant class and bactericides were found to be valuable materials, in general, for treating nets. The proper handling of nets and preservative treatments, including the application of preservatives to nets, was studied in order to cut down labor cost and to minimize fire risk.

So many factors enter into the problem of prolonging the life of nets that these investigations have been pursued along four general lines of study as follows: (1) Development of chemical preservatives, (2) method of application of chemicals to textiles, (3) differences in deterioration by localities, and (4) yearly variability of deterioration in one locality.

#### NUTRITIVE VALUE OF MARINE PRODUCTS

Marine products represent an important food supply. These products are, generally speaking, rich in vitamins, and minerals in quantity and variety.

Cooperative research with the Bureau of Chemistry and Soils, U. S. Department of Agriculture, on fish oils, fish meals, fish flour, and oysters has been continued. Chemical and spectrographic analyses of the mineral elements in fish and shellfish meals and kelp meals have been conducted at Johns Hopkins University. A plan of cooperative research in the laboratories of the South Carolina Food Research Commission at Charleston, S. C., has been initiated in which a study is being made of the mineral content of oysters with relation to the prevention and cure of nutritional anemia. Various other cooperative tests with Federal and State agri-



cultural experiment stations have been provided to extend the nutritional studies of marine products to farm animals.

The number of nutritional studies relating to and depending on other phases of the bureau's technological investigations, together with demands for nutrition investigations from the industry, have compelled the bureau to establish its own nutrition laboratory. This has been done, and the investigations already under way are taxing the facilities of this laboratory.

The outstanding contribution, resulting from research in this field of technology, has been the demonstration of the richness of domestic fish oils in vitamins A and D. The quantities of the above-described American fish oils available at present are sufficient to take care of any present or increasing future needs. The increased utilization of these domestic fish oils for medicinal use and for animal feeding will add to the economic wealth of this country, benefiting both our agricultural and fishery industries, and will lessen our dependence on foreign sources of supply.

Recently considerable interest has been shown in fish flour—a product at the present time being prepared experimentally from the edible parts, including the backbone, of fish remaining from the filleting or packaged fish industry. This product is dried at a low temperature, under vacuum, and ground into a fine meal or flour. It has a pleasant taste, odor, and an attractive appearance. It can be made cheaply, as it comes from raw material which is now either a waste or is converted into fish meal for animal feeding. It may contain as high as 28 to 30 per cent of minerals, consisting largely of calcium and phosphorus. Laboratory investigations and baking tests, conducted by the cereal laboratory of the Bureau of Chemistry and Soils in cooperation with this bureau, have demonstrated that it is possible to incorporate 10 to 25 per cent of this fish flour in bakery products of a palatable and nutritious nature designed especially to appeal to children. Fish flour should be of considerable value in bone growth. Arrangements have been made with a public institution to make a special study of fish flour in the diet of children. Cooperation of the District of Columbia medical and dental societies has been extended to the bureau in connection with these tests.

#### GLoucester Laboratory

The bureau has established a large field laboratory at Gloucester, Mass., for the general conduct of technological research, including the following activities: Refrigeration, smoking, canning, bacteriology, by-products, and production methods. This laboratory has been equipped for both chemical and technological research and special equipment will be added from time to time as its research activities are expanded.

The first experimental projects to be started are: (1) Studies of improvements in methods of manufacture of fish flour and fish meal; (2) an investigation of the vitamin potency and chemical characteristics of haddock liver oil; (3) chemical studies of the refrigeration of fish; (4) methods for smoking fish; and (5) bacteriological studies aimed to improve fish products.



## BIOLOGICAL FISHERY INVESTIGATIONS

The research activities of the scientific staff are addressed to the conservation of the Nation's aquatic food resources through encouraging and advising the States in their regulation of commercial and sport fishing, in perfecting methods of water farming and fish culture, and in providing the industries with sound and, in some cases, advance information as to the trend of the supply of commercial fishes. Major projects of research are conducted in each of the geographical interior and coastal sections of the United States.

Early in the fiscal year the division undertook an investigation of the haddock fishery—the most important fishery of the New England area. The fishery is subject to considerable fluctuations in yield; and recent evidences of decline in abundance, coupled with a tremendous expansion of the industry as a result of the packaged-fish business, have given rise to fears of serious depletion in the fishery. A comprehensive plan of investigation in the interest of conservation and the proper development of the resource, involving studies of changes in abundance of the stock and the possibilities of serious depletion, has been adopted, but such studies require considerable time for the production of results of practical value. Nevertheless, one phase of the investigation already has yielded results which promise to have signal value to the industry. A new type of savings trawl has been developed to permit the escape of virtually all fish below commercial size limits without reducing the catch of marketable fish. If this is adopted by the fishing industry, it should not only accomplish material economies in operation of the fishing vessels, but should be a positive factor in the conservation of the stock of fish in the sea.

Near the end of the fiscal year an agreement was reached with the California Division of Fish and Game for the conduct of a cooperative investigation of the trout and steelhead salmon situation in that State, and it is anticipated that the investigation will eventually include other Pacific coast areas. The streams of the western mountains have become so popular with anglers and vacationists that they are no longer able to withstand the strain of intensive fishing. New and improved methods of fish culture, of stocking, and of regulation must be devised and adopted to protect and augment the steelhead salmon runs and the trout supplies of these waters, and an investigation has been planned under the auspices of the two organizations uniting skill and material facilities on a large scale in the hope of meeting the situation.

## FISHERY INVESTIGATIONS OF THE ATLANTIC AND GULF COASTS

Investigations of the changing abundance of the more important food fishes along the Atlantic coast and the causes of such changes with their implications as to remedial measures have proceeded with gratifying results. Fluctuations in the mackerel fishery continued to follow the principle of dominant year classes with a consistency that promises increased accuracy of predictions as more seasons are added to the experience upon which forecasts are based.

Much of the work at sea has been greatly handicapped through the lack of a fisheries research ship capable of operating trawls and

performing related duties in connection with the various problems. The rectification of this condition is urgent.

Continuation of the investigation of the shore fisheries of southern New England and the Middle Atlantic States has confirmed the view that fluctuation in yield of several important species is due to natural causes largely. In the case of scup and butterfish, dominance of the fishery by occasional exceptionally large broods is largely responsible for variation in the yield. In the case of squeteague, the causes have been found to be more complex and are not yet completely understood.

Investigations were continued on the seasonal occurrence of pelagic marine fish eggs and young fish at the entrance of Chesapeake Bay. During 1930-31 records of the new winter trawl fishery, which has developed recently off the Virginia and North Carolina coasts, were secured. This fishery is of special interest, since it provides employment for a number of otherwise idle northern vessels, supplies an important fresh-fish market in the seasons of scarcity, and opens to exploitation the species of fish formerly caught only in the summer season. In upper Chesapeake Bay an investigation of the striped bass or rockfish has been undertaken to study the life history and habits of the fish as a basis for regulations, which appear to be badly needed for the protection of the supply.

To provide further fundamental information as to the lives and habits of the important food fishes of the South Atlantic coast, studies on the development of the young of the shore species were continued at the Fisheries Biological Laboratory, Beaufort, N. C., where special facilities for such studies are available. One report on this subject was recently issued and another dealing with several species is nearing completion. At this station also improvements in the methods of feeding young diamond-back terrapin have been developed.

Although of commercial importance for a half century, the shrimp has achieved a place among the important fisheries only within the past 10 or 15 years. The growth of this industry has been so rapid and has reached such magnitude that grave fears as to the permanency of the supply have been entertained by the industry, and the investigation started during the last half of the fiscal year gives every promise of providing the necessary information for the enactment of regulatory legislation should that be necessary to insure continued productivity of the resource.

A special study is being made in Georgia of the effects of the shrimp trawl upon the food and game fishes of the area.

#### FISHERIES OF INTERIOR LAKES

Investigations of the commercial fisheries of the Great Lakes were continued during the fiscal year 1931. Three different types of research were carried on in the Great Lakes, viz, a study of the effect upon the fish stock of commercial fishing gear and studies of experimental gear designed to prevent the destruction and waste of undersized fish; investigations of the life histories of important commercial fish of the Great Lakes; and limnological surveys in Lake Erie to study the conditions of the environment affecting fish production.

Studies of the trap-net fishery in Lake Erie were completed during the year and recommendations will be offered for an improved type

of gear. Similar studies with gill nets were conducted in Green Bay, Lake Michigan, and in Lake Huron. In Lake Michigan a comprehensive program of experimental fishing with gill nets at numerous points typical of the entire lake has been continued, employing the fisheries motor ship *Fulmar*, in an effort to perfect fishing gear which will be effective for catching chubs without at the same time destroying a great number of immature lake trout. Experimental fishing-gear studies have contributed much information on the life histories of the important fishes taken, and such data accumulating as the field work progresses will be of material value in the drafting of fishery regulations by the various States.

Field studies on the international dispute concerning pike-perch fishing in Lake Champlain were completed during the fiscal year, and a report is in process of preparation.

In the Wisconsin lakes detailed studies of the rate of growth of various food and game fishes were made by the bureau's investigators in the hope of correlating these data with the great mass of limnological observations obtained by the Wisconsin Geological and Natural History Survey in a study of the factors affecting fish growth and reproduction.

#### FISHERIES OF THE PACIFIC COAST AND ALASKA

The results of fishery investigations in Alaska are utilized throughout the fishing season and from year to year in the formulation and in the prompt application of fishery regulations over the entire area in the interest of conservation. A knowledge of the routes of migration of the important salmon runs, enumeration of spawning fish passing weirs on their way to headwaters of streams for propagation, and the age composition of the various runs are essential to the bureau's program of regulation of the fisheries. During the fiscal year the third section of the report on the statistics of the Alaska salmon fishery was completed for publication. This report covers the statistics from earliest times to 1927 for the Prince William Sound and adjacent territory.

An important contribution to the knowledge of the biology of the Pacific herring was published during the year, and a second report on the fluctuations in the supply of herring in Prince William Sound has been prepared. The herring fishery has suffered depletion in restricted areas, and scientific information obtained from these studies has been of assistance in placing additional restrictions upon the fishery to prevent exhaustion in areas now productive.

During May, 1931, another regular biennial census of the razor-clam beds near Cordova, Alaska, was made to determine the state of the resource, in order that canning operations in that vicinity may be so regulated as to permit continued productivity of the beds.

In the United States, salmon investigations by the bureau have been restricted to the Columbia River. One new marking experiment dealing with land-locked salmon of that river was initiated during the spring of 1931, and the records of recovered fish resulting from previous marking experiments on other species were collected and analyzed.



## FISH SCREEN AND FISH LADDER INVESTIGATIONS

The investigational work pertaining to the conservation of fish by means of screens and ladders has been continued without interruption. Field experiments with the electric screen have led to the adoption of simplified and improved apparatus. The highly satisfactory action of the electric screen in preventing upstream migrants from entering tail race waters was maintained during the past season. However, its effectiveness will never be 100 per cent, and there is a tendency on the part of the public to be apprehensive of the electric screen. On all new projects and wherever possible elsewhere the recommendation of the bureau is for the mechanical, revolving screen—a device which is unpatented and one which long use has proved to be entirely effective and reliable. The bureau continues to operate with success its electric screens in the Yakima country, where it is now impracticable to install mechanical screens. A development of the season's work was the discovery of the improvement that can be effected in leading migrating fish to by-pass channels by the use of lights. A survey has been made of fish-screen problems in Montana, and the bureau now has under construction a mechanical screen for the Jocko Canal and is preparing detailed plans and specifications for a mechanical screen (the largest ever constructed) on the Sun River Canal of the United States Reclamation Service.

In the fall of 1930 the bureau designed and constructed two concrete fish ladders on Government projects, these being located at Sprague River Dam in Oregon and at Wapato Dam in Washington. Both structures are similar in design to the successful ladder built by the bureau at Sunnyside Dam. During the winter the fish ladder requirements of the State of Maine were examined and reported on. In Idaho, special fishway problems received attention.

Considerable work has been done in connection with hydroelectric developments proposed or now under construction on streams supporting migratory fish. Applications for power licenses have been studied, field examinations made, and the proper fish-protective devices specified. Miscellaneous activities of the investigation have included engineering services in the preparation of designs for the water supply at the proposed new Butte Creek hatchery and for the new pumping equipment and distribution system at Clackamas hatchery.

## AQUICULTURAL INVESTIGATIONS

Facilities for investigations in the interest of fish culture were materially increased during the fiscal year by improvements at the Fairport (Iowa) station, where pond facilities were nearly doubled. This station has become a prime factor in the bureau's fish-cultural activities, for the principles of black-bass culture which have been developed here are being generally adopted throughout the country at large wherever conditions are suitable. The output of fingerling bass which resulted as a by-product of the experimental work was of material aid in filling requests for fish for planting. Similar investigations to adapt the new principles to local conditions have been undertaken at several of the fish-cultural stations, and studies are



being conducted in the Upper Mississippi Wild Life and Fish Refuge, where it has been demonstrated that the sloughs and ponds adjacent to the Mississippi River can be used to produce black bass in considerable quantities.

Trout-cultural investigations were continued at the Pittsford (Vt.) experimental hatchery where feeding experiments have been under way for several years. Additional foods have been tested, the most striking results being obtained from the use of dried salmon eggs. Commercial fish meals were also employed and superior rations have been devised at material savings in cost over foods generally used in hatcheries. Breeding experiments to develop brood stocks of superior quality, which were begun several years ago, have been continued, and experiments in stocking local waters with black-spotted trout and Montana graylings have been notably successful. At this hatchery the diseases of trout were also studied.

An investigation which promises to become of considerable importance has been undertaken on the diseases of the sea herring of the coast of Maine.

An important part of the bureau's pathological studies has been conducted in numerous hatcheries throughout the eastern section of the United States.

#### SHELLFISH INVESTIGATIONS

The bureau's investigations of shellfish, aside from the razor-clam census referred to in connection with Alaska fishery investigations, include two distinct and totally unrelated projects. One deals with the oyster fishery and the cultivation of oysters on the eastern and western coasts of the United States as well as the Gulf area, and the other deals with the fresh-water mussels of the Mississippi River and the attendant problems of pollution.

Oyster investigations were conducted during the fiscal year 1931 in Southern New England, Chesapeake Bay, in various South Atlantic States, and on the Pacific coast. A study of causes of mortality of oysters in the lower Chesapeake Bay was finished and a preliminary report issued. The results of this work, which began in May, 1930, and which was carried out in cooperation with the Fisheries Commission of Virginia, show that the mortality of oysters in 1929-30 was caused by the concurrence of a number of unfavorable factors, namely, low oxygen tension in the water during the fall and winter of 1929, planting oysters on soft bottoms, and overcrowded conditions in some of the planted areas. The report stresses the necessity of employment of better oyster-cultural methods, and outlines the general policy for the development and maintenance of public reefs in the State of Virginia.

The main difficulty in the South Atlantic States is the overcrowding of oysters by a new crop of seed oysters that set on the old ones. It is planned to develop a method of control of setting whereby the crowded conditions on the reefs can be overcome. In several localities substantial areas of oyster bottoms were set aside for experimental purposes.

In New York and Connecticut the work on the method of control of starfishes and other enemies of oysters has been continued.

Numerous experiments made with different toxic substances have shown that positive results could be expected only with various copper salts.

In cooperation with the State department of fisheries there has been established at Olympia, Wash., a laboratory adapted for research on problems of the oyster industry of Puget Sound. An investigation of the effect of pulp-mill wastes on oysters, which has been carried on since 1929, has been completed and the report is in press. Present investigations deal primarily with the methods of cultivation and the biology of the native oyster. An investigator also was stationed on the Oregon coast to study local problems and to assist in developing improved practices in oyster culture.

Investigations of fresh-water pearl mussels, which provide raw material for the great American button industry, were conducted from laboratory headquarters at the University of Missouri and at various places along the Mississippi River and its tributaries from a floating laboratory loaned by the United States Army engineers and later purchased from them. These investigations are primarily aimed at the perfection of new methods of mussel culture devised in previous years' studies to propagate fresh-water mussels by means independent from fishes of the locality, which in nature must serve as hosts during the parasitic stage of the development of mussel larvæ. Immediate adoption of this method of culture on a commercial scale is prevented by the existence of sufficient pollution from industrial and domestic sources in the entire upper Mississippi River and in many of its tributaries to kill the young mussels. Accordingly, a critical study of this pollution factor has also been undertaken.

Surveys of other river systems, including those of Texas flowing directly into the Gulf of Mexico, have resulted in discoveries of considerable areas of river bottoms suitable for the propagation of mussels. A further survey is being organized to study the Mississippi River conditions south of Keokuk Dam and along the Ohio and Tennessee Rivers. In the course of this expedition with the floating laboratory, quantities of mussel spawn will be propagated and planted as suitable water areas are encountered. Plans have also been made to establish a mussel-rearing station at the bureau's fish hatchery at Fort Worth, Tex., for the stocking of waters in that region.

The War Department's program calling for the construction of a score of dams and a 9-foot ship channel in the upper half of the river has aroused the fears and protests of fishermen and sportsmen throughout the region. At the request of the War Department, therefore, the bureau undertook a survey of the area involved in order to ascertain what would be the probable effects upon the fish and mussel fauna of the canal and water storage projects. A detailed limnological survey was completed early in the fiscal year and a preliminary report was presented to the War Department summarizing the findings. This report pointed out that if pollution and silting of the river were first corrected, the canalization project would not be harmful, and indeed might be beneficial to fish life in that area.

## ALASKA FISHERIES SERVICE

## ADMINISTRATION OF FISHERY LAWS AND REGULATIONS

The execution of the laws and regulations for the conservation of the fisheries of Alaska was continued in accordance with the policy adopted when the White law of June 6, 1924, gave the Secretary of Commerce broad powers with respect to control of the time, place, and method of commercial fishing. As salmon yield greater wealth than any other natural resource of Alaska, particular attention was given to conservation measures affecting this fishery. Extreme fluctuations characterized the salmon runs in the calendar year 1930, necessitating sharp curtailment of commercial fishing in some places in order that no cyclical recurrence of the shortage might be caused by lack of seeding of the spawning beds. The Commissioner of Fisheries was in Alaska for a number of weeks during the active salmon-fishing season, giving personal attention to various fishery problems.

Revised fisheries regulations were issued December 18, 1930, to be effective in 1931. These have since been modified by a number of supplementary orders, including the temporary closing during the 1931 season of certain areas in southeastern and central Alaska which will eliminate the operation of some 150 traps. The boundary of the Yukon-Kuskokwim area has been extended and additional waters in that area have been opened to limited commercial fishing for salmon.

Twelve statutory employees and 232 temporary stream guards and special workmen were identified with the patrol of the fishing grounds in the calendar year 1930, in addition to the crews of 15 bureau vessels and 10 chartered boats. Launches were used by many of the stream guards stationed at the mouths of salmon streams and in other closed areas to prevent illegal fishing. As in the previous season, a supplementary patrol by aircraft was maintained from time to time, chiefly in southeastern Alaska during the weekly closed periods.

Much was accomplished in the improvement of salmon streams by the removal of obstructions that hindered the ascent of salmon to the spawning grounds. The destruction of predatory species of fish that feed upon young salmon was actively carried on in the Bristol Bay region. Territorial assistance in providing funds for these purposes was of material advantage. At its 1931 session the legislature appropriated \$25,000 for continuance of this work during the next two years.

## ALASKA SALMON HATCHERIES

At the Government hatcheries at Afognak and on McDonald Lake 33,731,790 red-salmon eggs, 18,019,470 pink-salmon eggs, 100,000 chum-salmon eggs, and 123,904 steelhead-trout eggs were collected in the calendar year 1930. Shipments totaling 16,262,776 pink-salmon eggs and 3,055,000 red-salmon eggs in the eyed stage were forwarded to Seattle for distribution. At the privately owned hatchery operated under the provisions of the Alaska fisheries act of June 26, 1906, 21,190,000 red-salmon eggs were collected.



## SPECIAL STUDIES AND INVESTIGATIONS

Life-history studies of the Pacific salmon were continued, dealing primarily with the red-salmon runs of Bristol Bay, Karluk, Chignik, and Copper River, and the pink-salmon runs in southeastern Alaska. To develop further information regarding migration routes approximately 3,500 salmon, chiefly pinks, were tagged and released from traps in the vicinity of Cape Fox and on the east coast of Prince of Wales Island. Weirs to count the escapement of spawning salmon were operated in 26 typical salmon streams, of which 9 were in southeastern, 13 in central, and 4 in western Alaska. Investigations concerning the Alaska herring were also continued.

## PRODUCTS OF THE FISHERIES

Salmon products comprised about 70 per cent in quantity and 84 per cent in value of the total output of the Alaska fisheries in the calendar year 1930. Approximately 93 per cent of the salmon products consisted of canned salmon, the pack amounting to 5,032,326 cases, or 241,551,648 pounds, valued at \$29,694,898. As compared with the pack of the preceding year, the output of canned salmon in 1930 showed a decline of 6 per cent in quantity and 27 per cent in value. The heavy loss in value was attributable partly to the generally lower level of prices and partly to the shortage of red salmon. An unusually large proportion of the Alaska pack was made up of pink salmon, the price of which fell to but one-third of that of red salmon.

The quantity of herring products exceeded that of the preceding year, the gain being reflected entirely in the output of the pickled product. Prices on this commodity, however, as well as of meal and oil, showed a considerable decline, and the total value of herring products was the lowest since 1923. The halibut industry also was severely affected by economic conditions; as a result of curtailment of operations and of poor fishing in some localities there was a reduction of approximately 16 per cent in the quantity landed by the Alaska fleet, while the value declined 32 per cent from that of the preceding year. The production of clams and shrimps increased in both quantity and value. Cod fishing from shore stations decreased considerably, while whaling and virtually all of the minor fisheries were conducted on about the same scale as in 1929.

The total yield of the Alaska fisheries in the calendar year 1930 amounted to 370,990,360 pounds of products, valued at \$37,679,049, as compared with an average of 370,353,764 pounds, valued at \$48,042,667, for the 5-year period from 1925 to 1929, inclusive. The value of the 1930 catch to the fishermen was approximately \$12,285,000, or about \$4,297,000 less than in the preceding year. There were 27,568 persons employed in the various branches of the industry, as compared with 29,283 in 1929.

## ALASKA FUR-SEAL SERVICE

## GENERAL ACTIVITIES

An outstanding example of international cooperation is shown in the splendid results achieved under the convention of 1911 for the

protection and conservation of the North American fur-seal herd, which has its breeding grounds at the Pribilof Islands, Alaska. Since 1911 there has been a steady growth of the herd, numbering at that time about 125,000. There has also been a corresponding development of facilities for the expeditious conduct of the work at the Pribilof Islands.

Sealing operations in the season of 1930 included the taking and curing of sealskins and the marking and reserving of an adequate number of 3-year-old male seals for future breeding stock. For the first time there were no fall killings, as the plan has been adopted to preserve in cold storage such seal meat as may be required for food by the natives during the winter. Attention was given to the care of herds of blue foxes on St. Paul and St. George Islands and to the taking of fox skins.

Good progress was made during the year in the construction of new buildings, the erection of a dock at East Landing, and the extension of improved roads. The new by-products plant, which was begun in the spring of 1930, was completed; and equipment was installed in the season of 1931.

The service of the new tender *Penguin* was of very material advantage in the conduct of the bureau's work at the Pribilofs. A number of voyages were made to Seattle during the year, as well as frequent interisland trips and contacts with points along the Alaska Peninsula.

A staff of employees at the Pribilofs directed the work performed by resident natives and by temporary native workmen from the Aleutian Islands and the mainland who assisted with the work in the summer. The temporary labor is employed at a specified wage, but the Pribilof natives are virtual wards of the Government who are provided with the necessities of life, including medical and educational aid, in return for their services. They receive cash payments also, at the rate of 75 cents for each sealskin and \$5 for each fox skin taken, as well as some additional compensation for special services. At the close of the calendar year 1930 the native population of the Pribilof Islands numbered 375 persons.

The annual supplies for the Pribilof Islands were transported from Seattle, Wash., on the U. S. S. *Sirius*, through the cooperation of the Navy Department. The vessel carried a shipment of sealskins on the return voyage. Assistance was rendered also by the U. S. Coast Guard in patrolling waters frequented by the fur-seal herd.

#### SEAL HERD

Computations showed a total of 1,045,101 fur seals in the Pribilof Islands herd on August 10, 1930—an increase of 73,574 animals, or 7.57 per cent, over the corresponding figure for 1929.

#### TAKE OF SEALSKINS

In the calendar year 1930 there were taken on the Pribilof Islands 42,500 fur-seal skins, of which 34,382 were from St. Paul Island and 8,118 from St. George Island. This was an increase of 2,432 over the number taken in 1929.

## MARKING RESERVED SEALS

In the calendar year 1930 there were marked and reserved for future breeding stock 6,539 three-year-old male seals, of which 4,918 were on St. Paul Island and 1,621 on St. George Island. Included in the reserve also were a large number of seals of this age class that were not taken up in the drives.

## SALE OF SEALSKINS

Two public auction sales of fur-seal skins taken on the Pribilof Islands were held at St. Louis, Mo., in the fiscal year 1931. On September 15, 1930, there were sold 11,675 black-dyed, 8,307 logwood brown-dyed, and 99 miscellaneous un-haired and raw-salted skins for a gross sum of \$357,990.25. In addition 1 confiscated skin dressed in hair brought \$1.75.

At the second sale, held on March 30, 1931, 11,503 black-dyed and 9,568 logwood brown-dyed skins were sold for \$453,699.75. At the same time 137 black-dyed and 33 raw-salted Japanese fur-seal skins sold for \$3,172. These 170 skins were the United States Government's share of sealskins taken by the Japanese Government in 1929. There were also sold 2 confiscated fur-seal skins, which brought \$1.

Special sales of sealskins authorized by the Secretary of Commerce in the fiscal year 1931 consisted of 110 black-dyed, 188 logwood brown-dyed, 50 raw-salted, and 16 miscellaneous skins for display purposes, at a total of \$10,068.74. All were taken at the Pribilof Islands.

## FOXES

The management of blue-fox herds on St. Paul and St. George Islands as an adjunct to the fur-seal industry gives work to the natives in the winter when sealing activities are at a minimum and is the source of no little revenue to the Government from the sale of the pelts.

Seven hundred and forty-five blue and 32 white fox skins taken in the season of 1929-30 were sold at public auction in the fiscal year 1931. The blue pelts brought \$26,743 and the whites \$992, a total of \$27,735.

In the season of 1930-31, 211 blue and 24 white fox skins were taken on St. Paul Island and 678 blue and 2 white skins on St. George Island, a total of 915 skins. Fifty foxes on St. Paul Island and 313 on St. George Island were trapped, marked, and released for breeding purposes. The breeding reserve includes also a considerable number of foxes that were not captured during the season.

## FUR-SEAL SKINS TAKEN BY NATIVES

Pursuant to the provisions of the North Pacific Sealing Convention of July 7, 1911, Indians under the jurisdiction of the United States and Canada took 2,832 fur-seal skins which were duly authenticated by officials of the respective Governments. Of these skins,



85 were taken by natives of southeastern Alaska, 450 by natives of Washington, and 2,297 by natives of British Columbia. Through the courtesy of the Interior Department the superintendent of the Neah Bay Indian Agency authenticated the skins taken by Indians of the State of Washington.

#### FUR-SEAL PATROL

A patrol of the waters frequented by the Pribilof Islands fur-seal herd was maintained by vessels of the United States Coast Guard, supplemented in the spring by two of the bureau's fishery patrol vessels which traversed the waters in the vicinity of Cape Flattery and off the coast of southeast Alaska.

#### PROTECTION OF SEA OTTERS, WALRUSES, AND SEA LIONS

No changes were made in the regulations previously issued for the protection of sea otters, walruses, and sea lions. The killing of sea otters is prohibited at all times. There is a closed season at all times on walruses and sea lions, although certain limited killing is permitted under specified conditions.

#### BLACK BASS LAW ENFORCEMENT

With the transfer of Talbott Denmead, formerly assistant United States conservation officer of the Biological Survey, from the Department of Agriculture to the Department of Commerce to fill the newly created position of law enforcement officer, the new black bass law enforcement division of the bureau was formally inaugurated. The appropriation for the fiscal year 1932 will permit the bureau to employ one more full-time inspector, and perhaps several part-time ones, which positions will be filled in the near future.

With this small force it was found necessary to create the cooperative position of deputy black bass law inspector, without salary, appointees to be generally limited to regularly employed State fish and game protectors. While fully realizing that unpaid deputies are not always satisfactory, it is felt that much can be accomplished in this manner at present that could not be done in any other way.

The law enforcement officer has visited and held important conferences with State game officials and others in Pennsylvania, Minnesota, Wisconsin, Illinois, and the New England States relative to the enforcement of the black bass law. Inspections of Baltimore fish markets have been made regularly.

As the Federal statute is predicated on an infraction of State law, it is essential that the various State laws relating to closed seasons, limits, sale, and transportation of black bass be made readily available to all interested, including Federal and State officials, commercial fishermen, fish dealers, and sportsmen. Bureau officials have been steadily engaged for several months in a study of the game fish laws of the 48 States, and rapid progress has been made. The largest part of this rather complicated task is completed, and it will shortly be possible to issue in printed form a synopsis of the State game fish laws, along with the Federal black bass law and other data.

Numerous reports of alleged infractions of the Federal black bass law have been received from Kentucky, Maryland, Virginia, Arkansas, Alabama, Mississippi, and other States, but investigations in most instances disclosed no violations of the Federal statute. In several cases it was found that fish other than black bass were involved, and in others violation of State law could not be proved.

An excellent spirit of cooperation was received from the State fish and game departments, anglers, and others, and it is believed the law will be reasonably observed after it receives publicity and its provisions are fully understood. With this end in view numerous articles have been carefully prepared and published in fish and game magazines, the press, and other publications, covering the main features of the law, its aims and objects; addresses and radio talks by members of the bureau and others have explained the law, and about 2,000 copies have been distributed. The general correspondence resulting from this publicity has been large and covers many subjects relating to game fish, and the bureau has received many requests for advice and assistance in matters pertaining to game fish.

An excellent start has been made on the work in the three months since the inauguration of the division, and it enters the fiscal year of 1932 better prepared to carry out the provisions of the law.

#### VESSEL NOTES

The *Albatross II* was engaged throughout the year in scientific research work between Cape Sable, Nova Scotia, and Cape Hatteras, N. C., between the shore line and continental shelf. Oceanographic stations numbering 286 were made. Numerous 30 and 60 foot otter-trawl hauls were made. During the investigations there were tagged 352 cod, 280 haddock, 33 pollock, and flukes, sea bass, scup, butterfish, and croakers numbering 248 in all. At convenient times, between cruises, the vessel underwent various repairs at the Boston Navy Yard. The work was under the direction of O. E. Sette.

The steamer *Shearwater* was engaged in fish-cultural work at the Put in Bay (Ohio) station during the fall and spring months.

The steamer *Phalarope* was engaged as usual as a tender at the Woods Hole biological station.

The *Pelican* which was launched at Newport News, Va., last June is now at the Boothbay Harbor (Me.) station. It has been engaged throughout the year in fish-cultural activities.

The bureau's vessel *Fulmar*, a motor ship 102 feet long stationed at Charlevoix, Mich., was assigned to investigative duty with the Great Lakes scientific staff and has been fully equipped for experimental fishing. The vessel has been engaged in experimental work on Lake Michigan for the purpose of studying means of preventing the destruction of undersized and immature fish by commercial nets. Extensive biological data upon the life histories of these fishes and on problems of their conservation were obtained. The investigations continued from June to November, 1930, and were resumed again in May, 1931. Experimental fishing stations were occupied weekly throughout the season at numerous points distributed around the margin of the lake.

Sixteen vessels of the Alaska service cruised more than 140,000 nautical miles in the fiscal year 1931, as compared with 118,570 nauti-

cal miles in the previous year. The *Penguin* covered approximately 24,000 miles; the *Crane*, 15,000 miles; and the *Brant* and *Teal* each about 13,000 miles.

The *Penguin*, newest and largest of the bureau's Alaska vessels, was used chiefly as tender for the Pribilof Islands, although some incidental service was rendered the salmon-fishery investigations for two weeks in September. This vessel has proved a highly satisfactory addition to the Alaska fleet.

In southeastern Alaska the *Widgeon*, *Murre*, *Auklet*, and *Petrel* were engaged in fishery protective work throughout the season. Other vessels employed in that district for a time in the fall after the close of fishing operations to the westward were as follows: *Crane*, which had been on duty in the Alaska Peninsula region and had transferred seasonal employees to and from Bristol Bay; *Teal*, which patrolled waters of the Cook Inlet area during the summer; *Scoter*, engaged on Bristol Bay; *Blue Wing*, employed at Kodiak and Afognak Islands; and *Kittiwake*, which was in the Seward-Katalla district until September 10. The *Eider* and *Red Wing* were stationed in the Kodiak-Afognak district; the *Ibis* at Chignik; the *Merganser* in the Ikatan-Shumagin district; and the *Coot* on the Yukon River. The *Brant* was used in general supervisory work and made one cruise to the westward as far as Ikatan.

In addition to operations in connection with the fisheries in Alaska, the *Brant* was engaged for several weeks in patrolling waters of Neah Bay, Wash., and vicinity to enforce the laws for the protection of the fur-seal herd during its migration northward. The *Widgeon* performed similar duty off the coast of southeastern Alaska.

Nearly all of the Alaska vessels were given a general overhauling during the winter, either at Seattle or at one of the Alaska ports. The *Blue Wing* was extensively remodeled and was equipped with the 50-horsepower gas engine formerly in the *Scoter*.

#### APPROPRIATIONS

Appropriations for the bureau for the fiscal year aggregated \$2,631,885, as follows:

Salaries .....	\$860, 310
Miscellaneous expenses:	
Administration .....	4, 400
Propagation of food fishes .....	574, 000
Maintenance of vessels .....	169, 500
Inquiry respecting food fishes .....	172, 000
Fishery industries .....	87, 000
Sponge fisheries .....	3, 100
Construction of stations .....	265, 000
Enforcement of black bass law .....	6, 075
Protecting seal and salmon fisheries of Alaska .....	376, 500
Upper Mississippi Wild Life and Fish Refuge .....	25, 000
For improvements at the Fairport (Iowa) Biological Station .....	24, 000
By-products plant, Alaska .....	65, 000

2, 631, 885

Very truly yours,

HENRY O'MALLEY,  
Commissioner of Fisheries.







